

Waveguide

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A **waveguide** is a structure which guides waves, such as electromagnetic waves, light, or sound waves. There are different types of waveguide for each type of wave.

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Electromagnetic waveguides

Waveguides can be constructed to carry waves over a wide portion of the electromagnetic spectrum, but are especially useful in the microwave and optical frequency ranges. Depending on the frequency, they can be constructed from either conductive or dielectric materials. Waveguides are used for transferring both power and communication signals.

Optical waveguides

Waveguides used at optical frequencies are typically dielectric waveguides, structures in which a dielectric material with high permittivity, and thus high index of refraction, is surrounded by a material with lower permittivity. The structure guides optical waves by total internal reflection. The most common optical waveguide is **optical fiber**.

Other types of optical waveguide are also used, including photonic-crystal fiber, which guides waves by any of several distinct mechanisms. Guides in the form of a hollow tube with a highly reflective inner surface have also been used as light pipes for illumination applications. The inner surfaces may be polished metal, or may be covered with a multilayer film that guides light by Bragg reflection (this is a special case of a photonic-crystal fiber). One can also use small prisms around the pipe which reflect light via total internal reflection [1] (<http://www.physics.ubc.ca/ssp/research/lightpipe.htm>)—such confinement is necessarily imperfect, however, since total internal reflection can never truly guide light within a *lower*-index core (in the prism case, some light leaks out at the prism corners).

Acoustic waveguides

An *acoustic waveguide* is a physical structure for guiding sound waves. A duct for sound propagation also behaves like a transmission line. The duct contains some medium, such as air, that supports sound propagation.

Sound synthesis

Using digital delay lines coupled with digital filters.

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Category: Applied and interdisciplinary physics

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